



Repair and Replacement Guidance for Lock Culvert Valves

Problem

Many navigation locks maintained by the Corps have reached or exceeded their design life. Maintenance, rehabilitation, or replacement of lock culvert valves often requires engineering design. Operations personnel have expressed belief that troublesome valves are not stiff enough. Current design guidance for lock culvert valves (EM111-2-1610) has not been updated since 1975, while the corporate body of knowledge has dramatically increased since then. Current guidance also recommends a valve design that has been found to perform poorly and has been a maintenance problem. Field measurements have indicated that current design guidance underpredicts the expected loads a valve must withstand during operation. Valves in service have experienced cracking and excessive uplift forces, while cavitation has been a problem at some projects.



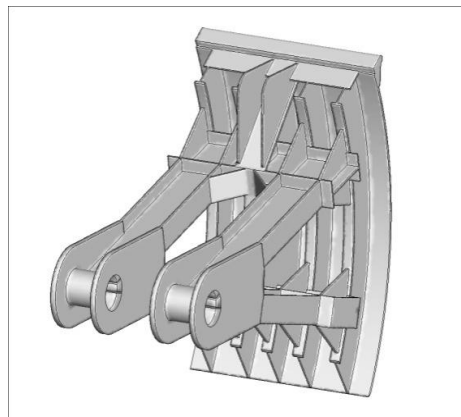
Double-skin plated valve (John Day Lock)

Approach

This research is focused on developing improved design guidance for lock culvert valves. Particular attention is being given to reverse tainter valves because they are the most common valve type found on USACE locks. The guidance will go beyond the current recommendations by pairing valve geometry (radial arms, lateral members, web members, etc.) with culvert size. Visits to navigation projects to observe operations and discuss maintenance history with lock operations and maintenance personnel have helped identify common troubles that particular valve designs have presented. Large-scale physical and computational flow models are being coupled with field and literature reviews to develop an understanding of the fluid/structure interaction within lock culverts. The physical models provide hoist loads and vibration tendencies. Three-dimensional computational models provide detailed understanding of pressure and flow distributions (and the corresponding hydraulic forces) acting on individual valve members.

Products

This research effort will produce Engineering Technical Letters containing information appropriate for an EM 1110-2-1610 update and technical reports. The publications will include items of interest to designers, such as head loss, cavitation potential, and hydraulic loads of common valve configurations. Technical papers and presentations will be given to engineering audiences. Workshops will be held for field engineers who design, operate, and maintain lock culvert valves. These workshops will relay research findings and provide design guidance.



Vertically framed valve (Watts Bar Lock)

Benefits

The research will provide a greater understanding of how to design and improve valves on existing navigation locks. Supplements to the lock valve design manuals will provide the most up-to-date guidance and criteria available for design and evaluation. Well designed valves will contribute to safer and faster lockages as well as decreased maintenance costs and a reduction in unscheduled outages required for valve repair.

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